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EDWIN DUNKIN, Esq., F.R.S., Vice-President, in the Chair.

John McCance, Esq., Rathfern, Rayners Road, Putney Hill, was balloted for and duly elected a Fellow of the Society.

## *On some Systematic Errors in the Determinations of the Semi-diameter of the Moon from the Greenwich Observations* 1750–1840.

By E. J. Stone, M.A., F.R.S.

The longitudes of the Moon's centre which are contained in the Greenwich Lunar Reductions, vol. ii., appear to be affected by considerable systematic errors directly connected with the reduction of the observations from the limbs to the centre. The excess of the observed longitudes of the centre over the tabular longitudes are given separately for each limb whenever both limbs are observed near the Full. I have extracted these quantities for groups of years identical with those adopted by Sir G. B. Airy for the determination of the coefficient of the parallactic inequality; and if $E_1$ and $E_2$ denote these excesses of observed longitudes from observations of the first and second limbs respectively, the mean values of $\frac{E_1 - E_2}{2}$ will be found, in my table, under the heading $\delta s$. I also give the values of the coefficient of the parallactic inequality deduced directly by Sir G. B. Airy, and their values when approximately corrected for the errors of semi-diameter $\delta s$.

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| Period. | Parallactic Inequality with adopted Semi-diam. | Correction. δs | Parallactic Inequality apparently corrected. |
|---|---|---|---|
| | ″ | ″ | ″ |
| 1750–1759 | 121·44 | +0·15 | 121·60 |
| 1755–1764 | 121·27 | +0·29 | 121·58 |
| 1760–1768 | 122·15 | +0·37 | 122·54 |
| 1765–1773 | 122·63 | +0·14 | 122·78 |
| 1769–1778 | 122·87 | +0·50 | 123·40 |
| 1774–1782 | 123·23 | +0·65 | 123·92 |
| 1779–1787 | 122·34 | +2·23 | 124·69 |
| 1783–1791 | 121·15 | +2·05 | 123·31 |
| 1788–1796 | 121·06 | +1·03 | 122·15 |
| 1792–1801 | 121·03 | +0·95 | 122·03 |
| 1797–1805 | 120·49 | +1·01 | 121·56 |
| 1802–1810 | 121·17 | +0·38 | 121·57 |
| 1806–1815 | 122·98 | +0·01 | 122·99 |
| 1811–1819 | 124·09 | −0·50 | 123·56 |
| 1816–1824 | 124·49 | −0·01 | 124·48 |
| 1820–1829 | 125·82 | +0·26 | 126·09 |
| 1825–1833 | 125·20 | +0·54 | 125·77 |
| 1830–1838 | 124·01 | +1·05 | 125·11 |
| 1834–1842 | 123·57 | +0·30 | 125·11 |
| 1839–1847 | 123·24 | +0·40 | 123·88 |
| 1843–1851 | 124·52 | +0·70 | 123·67 |
| 1847–1851 | 125·50 | +0·87 | 125·26 |
| 1851–1861 | 124·38 | +0·63 | 125·01 |
| 1862–1876 | 124·76 | +0·40 | 125·18 |

The result for 1851–1861 is the mean of the results for the two nine-year periods 1851–1859 and 1853–1861.

The Altazimuth Observations give

| | |
|---|---|
| 1848–1861 | 125″·64 |
| 1862–1878 | 125·06. |

The adopted mean semi-diameters are stated by Sir G. B. Airy to have been, 0·273036 × 3421″·8, or 15′ 34″·27, for the observations 1750 December 12, to 1815 August 19; and quantities sensibly agreeing with 0·27294 × 3421″·8, or 15′ 33″95, for the observations wth the New Transit from 1816 August 7 to 1839 December 31. From the year 1840 to 1861 values agreeing sensibly in mean results with Adams's value, 15′ 34″·68, appear to have been adopted; whilst in and after 1862 Hansen's value, 15′ 34″·08, has been adopted. An inspection of the values of δs shows at once that the forty-six-year period inequality,

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whose existence was first pointed out by Sir G. B. Airy in the values of the coefficient of the parallactic inequality deduced from a discussion of these observations, and which has recently been brought prominently before the Society as an inequality in the expression of the Moon's tabular longitude, is certainly directly connected with questions of semi-diameter. But it does not appear that any inequality with the same period and to the same amount is shown by our recent determinations of semi-diameter or coefficients of parallactic inequality.

The corrections $\delta s$ for the groups 1779–1787 and 1783–1791 are perhaps unduly increased by the presence in both groups of an error, 7″·6, which was found on 1874 Sep. 28. But if this observation should be rejected, the values of $\delta s$ would still remain 1″·82 and 1″·65 respectively, and the general law would therefore remain unchanged.

It appears to me most desirable that some competent person should re-examine the calculations of the parallaxes and semi-diameters which were actually used on the work prior to 1840, when Adams's parallax was practically adopted by the application of the necessary corrections to Burckhardt's values.

There is another point of view under which the collection of these values of the coefficient of the parallactic inequality may not be without interest. The value of the mean diameter of the Moon, near the Full, found from the observations with the Old Transit 1750–1815, does not greatly differ from the value found with the present Transit-Circle. It might therefore have been expected that the coefficient of the parallactic inequality determined from these early observations would not differ very much from the value given by the recent observations. But this is not the case. The coefficient given by the observations 1750–1815 is only 122″·6, a value which, curiously enough, differs but little from that which would be found if Encke's value of the solar parallax were adopted; but the value given by the recent observations is about 125″·2. The difference is serious, and cannot be dismissed as due to mere personality or as certainly due, without examination and proof, to differences of instrumental means; for the diameters determined with the different instruments have been used in passing from the observed limbs to the centre, and the results should therefore be free from error of semi-diameter.

But there are indications that the numerical values of the coefficient of the parallactic inequality increase as the optical power of the instrument employed on the observations is increased. If such is the case, the effective semi-diameters near Full Moon must sensibly differ from those near quadratures. There is undoubtedly one cause for such differences in instrumental irradiation; but it is very doubtful whether this can be the principal cause of the discordance, 2″·6, to which I have called attention. If such were really the case, we should expect the semi-diameter found from a discussion of the observations

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with the small instrument to be much larger than with the present Transit-Circle; and this is not the case. There is one cause which has occurred to me as a possible explanation of the observed discrepancy. The irregularities of the lunar surface subtend very sensible angles at the Earth; and these irregularities must present different aspects on the limbs when viewed under the different illuminations at Full and at quadrature; and the measured differences would most probably differ considerably with such very different instrumental means as those employed 1750–1815 and those in present use. There is an old transit instrument, with an aperture of an inch and a half, at the Radcliffe Observatory. I feel much tempted to mount the instrument and try whether there really does exist a difference between the effective semi-diameters near Full and quadrature sufficient to account for a discrepancy of 2″·6 in the values of the coefficient of the parallactic inequality as determined from observations with such an instrument and our present Transit-Circle. If such a discrepancy could be proved to exist, we should be able to infer with certainty the existence of some smaller correction in the same direction for our existing instruments; but if no such discrepancy should be found between the results, then there must be some very important error in the discussion of the early Greenwich results to have led to this constant difference.

## *On the Conjunctions of the Satellites of Uranus with each other, which may be observable from February to May* 1882. By A. Marth, Esq.

The following list is a continuation of that printed on p. 29, and contains the computed position-angles and distances, in reference to the centre of *Uranus*, of the satellites which pass one another, for the nearest even hours, Greenwich M.T., preceding and following the times of their conjunctions.

| | | | *Ariel.* | | *Umbriel.* | | *Titania.* | | *Oberon.* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | G.M.T. | Pos. | Dist. | Pos. | Dist. | Pos. | Dist. | Pos. | Dist. |
| 1882. | | h | ° | ″ | ° | ″ | ° | ″ | ° | ″ |
| Feb. | 1 | 12 | — | | 192·6 | 13·0 | 198·7 | 17·2 | — | |
| | | 14 | — | | 193·2 | 14·9 | 199·3 | 15·4 | — | |
| | | 16 | — | | 193·7 | 16·7 | 200·0 | 13·5 | — | |
| | 15 | 16 | 195·8 | 13·9 | — | | 190·1 | 9·9 | — | |
| | | 18 | 196·2 | 12·3 | — | | 191·0 | 11·9 | — | |
| | | 20 | 196·8 | 10·2 | — | | 191·7 | 13·8 | — | |
| | 18 | 14 | — | | 194·9 | 21·0 | 196·6 | 23·8 | — | |
| | | 16 | — | | 195·1 | 21·3 | 196·8 | 22·2 | — | |
| | | 18 | — | | 195·3 | 21·1 | 197·1 | 20·5 | — | |